Outer Planets Program

EUROPA ORBITER PRELIMINARY PLANETARY PROTECTION REQUIREMENTS

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Because of the potential for an ocean to exist under the Europan surface ice, there is a concern that microorganisms from Earth taken to Europa by the Orbiter could biologically contaminate Europa. The National Research Council's Space Studies Board is currently conducting a study of the planetary protection requirements that should be imposed on spacecraft traveling to Europa in order to prevent such contamination, given the natural environment of Europa (in orbit, on the surface, and what can be deduced about the subsurface). What follows are preliminary guidelines for planetary protection, subject to modification by NASA after the Space Studies Board's Task Force on Europa Forward Contamination issues their report (expected Fall 1999).

The requirements for Europa planetary protection are anticipated to affect the Europa Orbiter payload in one or both of two ways: by imposing overall spacecraft bioload reduction and/or orbital lifetime restrictions:

If the requirements for Europa planetary protection are partially to be met by overall spacecraft bioload reduction, the Orbiter remote sensing instrument package must be capable of being cleaned and/or tolerant of microbial reduction to a total number of spores on all free surfaces, mated surfaces, and encapsulated volumes (including the volume of non-metallic materials) to no more than 100,000 spores (subject to change). The total bioburden on exposed surfaces at launch shall not exceed 300 spores/m^2. Bulk (encapsulated in non-metallic materials) burden shall be estimated by standard planetary protection volume density specifications as defined in Appendix A of NPG 8020.12B, "Planetary Protection Provisions for Robotic Extraterrestrial Missions." The verification of compliance (surface assays and volume assay by proxy samples) will be performed at ALL stages of assembly. A plan for these regular assays at the location of fabrication is required. The plan must include number of assays, which surfaces, stage of assembly, etc. Dry heat microbial reduction may be employed. Alternative microbial reduction processes may be proposed, and actual demonstrations of efficacy demonstrated by appropriate test. Surface sterilization methods are not appropriate for mated and encapsulated burden. A contamination control plan demonstrating the plan to maintain the cleanliness of the instrument through delivery for integration is required. Quality assurance records of all assay results and all microbial reduction processes are required.

The entire fabrication of the instrument must occur in a class 100,000 clean room (or better). Stringent personnel garmenting and facility control requirements (e.g., personnel training) shall be observed. The clean room shall be bioassayed before equipment is put into it and periodically while equipment remains in it. Surface sterilization, if done by alcohol wipe, shall include all

exposed surfaces (i.e., all exterior surfaces and those interior surfaces that have a pathway to the exterior through which microorganism can be transported). Once sterilized, bioassays shall be taken (Q-tips or similar sampling devices in several spots) to monitor any microorganism growth. A statistically valid number of bioassay samples of exposed surfaces shall be taken from each assembly at the appropriate level of assembly.

Immediately after assaying, equipment shall be bagged and stored in a clean (class 100,000 or better) area. If any unbagged piece of flight equipment is moved outside of the clean room area, it must be re-cleaned. Any time the equipment is touched, it must be logged, cleaned, and bioassayed. For instruments and equipment delivered to the spacecraft, a final assay prior to bagging and/or delivery shall be conducted to determine the as-shipped condition.

The activities above must be costed by the instrument. The plans must be approved by the Project Planetary Protection Manager. The NASA Planetary Protection Officer must be allowed access at his/her discretion to verify the status of the instrument compliance during fabrication.

The above requirements are based on the expectation that it will be impossible to keep the Europa Orbiter from impacting the surface for more than a few months after loss of control of the vehicle, but that some of the requirements for bioload reduction will be satisfied by the radiation environment in orbit around Jupiter and Europa. If additional bioload reduction is required, the Project is expected to employ methods that are sparing of most spacecraft materials and sensor systems, but the compatibility of each instrument in the selected payload with these methods is not guaranteed.

In addition to bioload reduction, the Project is investigating the use of orbital inclinations of approximately 45° in order to extend the orbital lifetime of the spacecraft. This approach could eventually reduce requirements on bioload reduction; however, proposers should adopt only the requirements outlined above for the purpose of the their proposal. The science consequences of the lower inclination orbit strategy should be addressed as noted in Appendix B, Sections 3.3 and 4.3, and in Section 2.1.1 of the Europa Orbiter Mission and Project Description document in the Outer Planets Program Library, which can be accessed over the Internet through URL http://outerplanets.LaRC.NASA.gov/outerplanets.

The requirements listed above are subject to future change as the Europa planetary protection policies become better-defined. Nonetheless, proposers should submit plans and costs consistent with the above preliminary requirements.